

WHAT IS CLAIMED IS:

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5 1. A liquid discharge head comprising a heat generating element for generating thermal energy which is used for discharging liquid from a discharge port, and a protective layer provided on said heat generating element to protect said heat generating element,

10 wherein said protective layer has a first region with a substantially uniform and desired thickness and a second region with a substantially uniform thickness thinner than said desired thickness, the volume of liquid droplets discharged from said discharge port is changed by changing electric energy applied to said heat generating element.

15 2. A liquid discharge head according to claim 1, wherein said second region is provided on a side closer to said discharge port than said first region.

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20 3. A liquid discharge head according to claim 1, wherein said protective layer is composed of plural layered protective layers, said first region is composed of said plural layered protective layers, and any protective layer of said plural layered protective layers is removed in said second region.

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4. A liquid discharge head according to claim 3, wherein said second region is formed by forming the

upper protective layer after etching the lower protective layer.

5 5. A liquid discharge head according to claim 4, wherein said lower protective layer is composed of phosphosilicate glass film, said upper protective layer is composed of SiN film, and said etching is conducted with buffered hydrofluoric acid.

10 6. A liquid discharge head according to claim 3, wherein said plural layered protective layers are composed of materials each having different etching properties, and said second region is formed by forming said plural layered protective layers and subsequently
15 by selectively etching only the upper layer.

20 7. A liquid discharge head according to claim 6, wherein said lower protective layer is composed of SiN film, said upper protective layer is composed of phosphosilicate glass film, and said selective etching is conducted with buffered hydrofluoric acid.

25 8. A liquid discharge head according to claim 6, wherein said lower protective layer is composed of SiO₂ film, said upper protective layer is composed of SiN film, and said selective etching is conducted with hot-hydrofluoric acid.

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9. A liquid discharge head according to claim 1, wherein said heat generating element is composed of material having a positive temperature coefficient.

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10. A liquid discharge head according to claim 1, wherein said heat generating element is provided in plural numbers, a driving circuit having a plurality of function devices provided for independently driving said plurality of heat generating element is provided within the substrate on which said heat generating element is provided.

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15 11. A liquid discharge head comprising a heat generating element for generating thermal energy which is used for discharging liquid from a discharge port, a protective layer provided on said heat generating element to protect said heat generating element and a moving member provided facing said heat generating element and having a free end which is displaced in accordance with generation of a bubble due to said thermal energy,

20 wherein said protective layer has a first region with a substantially uniform and desired thickness and a second region with a substantially uniform thickness
25 thinner than said desired thickness, the volume of liquid droplets discharged from said discharge port is changed by changing electric energy applied to said

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~~heat generating element.~~

12. A liquid discharge head according to claim
11, wherein said second region is provided on a side
5 closer to said discharge port than said first region.

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10 13. A liquid discharge head according to claim
11, wherein said protective layer is composed of plural
layered protective layers, said first region is
composed of said plural layered protective layers, and
any protective layer of said plural layered protective
layers is removed in said second region.

15 14. A liquid discharge head according to claim
13, wherein said second region is formed by forming the
upper protective layer after etching the lower
protective layer.

20 15. A liquid discharge head according to claim
14, wherein said lower protective layer is composed of
phosphosilicate glass film, said upper protective layer
is composed of SiN film, and said etching is conducted
with buffered hydrofluoric acid.

25 16. A liquid discharge head according to claim
13, wherein said plural layered protective layers are
composed of materials having different etching

properties to each other, and said second region is formed by forming said plural layered protective layers and subsequently by selectively etching only the upper layer.

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17. A liquid discharge head according to claim 16, wherein said lower protective layer is composed of SiN film, said upper protective layer is composed of phosphosilicate glass film, and said selective etching is conducted with buffered hydrofluoric acid.

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18. A liquid discharge head according to claim 16, wherein said lower protective layer is composed of SiO₂ film, said upper protective layer is composed of SiN film, and said selective etching is conducted with hot-hydrofluoric acid.

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~~19. A liquid discharge head according to claim 11, wherein said heat generating element is composed of polycrystalline silicon.~~

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20. A liquid discharge head according to claim 11, wherein said heat generating element is provided in plural numbers, a driving circuit having a plurality of function devices provided for independently driving said plurality of heat generating element is provided within the substrate on which said heat generating

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The first part of the paper is devoted to the study of the asymptotic behavior of the solutions of the system (1.1) as $\epsilon \rightarrow 0$. In the second part, we study the asymptotic behavior of the solutions of the system (1.1) as $\epsilon \rightarrow 0$. In the third part, we study the asymptotic behavior of the solutions of the system (1.1) as $\epsilon \rightarrow 0$.

22. A liquid discharge method using a liquid discharge head having a heat generating element for generating thermal energy which is used for discharging liquid from a discharge port, and a protective layer for protecting said heat generating element, provided on said heat generating element, said protective layer having a first region with a substantially uniform and desired thickness and a second region with a substantially uniform thickness thinner than said desired thickness,

wherein a size of a bubble generated on said heat generating element is changed by changing electric energy applied to said heat generating element while keeping a region of the starting point of bubbling to said second region, whereby the volume of liquid droplets discharged from said discharge port is changed.

25 23. A liquid discharge method using a liquid
discharge head having a heat generating element for
generating thermal energy which is used for discharging

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liquid from a discharge port, a protective layer for
protecting said heat generating element, provided on
said heat generating element and a moving member
provided facing said heat generating element and having
5 a free end which is displaced in accordance with
generation of a bubble due to said thermal energy, said
protective layer having a first region with a
substantially uniform and desired thickness and a
second region with a substantially uniform thickness
10 thinner than said desired thickness,

wherein a size of a bubble generated on said heat
generating element is changed by changing electric
energy applied to said heat generating element while
keeping a region of the starting point of bubbling to
15 said second region, whereby the volume of liquid
droplets discharged from said discharge port is
changed.